

Application No.: 10/679,100
Applicant(s): Steve Berger and Lawrence Scipioni
Filing Date: October 3, 2003
Amendment Dated March 25, 2004
Reply to the Office Action of March 12, 2004

Attorney Docket No.: MIM-067.02

Amendments to the Claims:

This listing of claims will replace all prior version and listing of claims in the application.

Listing of Claims:

CLAIMS

1. (Previously Presented) An apparatus for imaging a cross-section of a workpiece, said apparatus comprising
a low brightness shaped-beam ion column for producing an ion beam, the column including an aperture positioned in the beam path to pass less than all the ions in the beam, the ion column oriented along a first axis and illuminating said workpiece to form a cross-section thereon, and
a focused-particle-beam column oriented along a second axis that intersects said first axis at a predetermined angle, said focused-particle-beam column generating a focused particle beam illuminating said cross-section.
2. (Previously Presented) The apparatus of claim 1 wherein said focused-particle-beam-column comprises a scanning electron microscope.
3. (Previously Presented) The apparatus of claim 1 wherein said focused-particle-beam column comprises a focused ion beam column.
4. (Previously Presented) The apparatus of claim 1 wherein said ion column includes an ion source having a brightness less than 100,000 amps per square centimeter per steradian.
5. (Previously Presented) The apparatus of claim 4 wherein said ion source has a brightness less than 10,000 amps per square centimeter per steradian.

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6. (Previously Presented) The apparatus of claim 1 wherein said ion column includes an ion source selected from a group consisting of a plasma source, a field emission gas ion source, a surface plasma source, and a liquid metal source.

7. (Previously Presented) The apparatus of claim 1 wherein said shaped-beam ion column comprises an ion source generating an ion beam, and

an ion-blocking mask having an aperture formed therethrough, said mask disposed between said ion source and said workpiece.

8. (Previously Presented) The apparatus of claim 7 wherein said shaped-beam ion column further comprises

a deflection plate disposed between said ion-blocking mask and said workpiece, and a voltage source connected to said deflection plate for placing an electric charge thereon.

9. (Previously Presented) The apparatus of claim 8 wherein said voltage source comprises a signal generator for placing a time-varying charge on said deflection plate.

10. (Previously Presented) The apparatus of claim 7 wherein said ion-blocking mask includes at least one straight edge producing a beam that etches at least one substantially straight edge on the work piece.

11. (Previously Presented) The apparatus of claim 1 wherein said pre-determined angle is between approximately thirty degrees and sixty degrees.

12. (Previously Presented) The apparatus of claim 1 in which the shaped-beam ion column includes a non-liquid metal ion source.

13. (Previously Presented) The apparatus of claim 1 in which the shaped-beam ion column includes a liquid metal ion source.

14. (Previously Presented) An apparatus for imaging a cross-section of a workpiece having a front surface, said apparatus comprising

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an shaped-beam ion-beam column switchable between a cutting mode in which a shaped beam limited by an aperture illuminates said workpiece, and an imaging mode in which a focused ion beam illuminates said workpiece, said ion beam column being oriented along a column axis, and

a workpiece support having a cutting position in which said support holds said front surface at a first angle relative to said column axis, and an imaging position in which said support holds said front surface at a second angle relative to said column axis.

15. (Previously Presented) The apparatus of claim 14 wherein said first angle is selected such that said column axis and said front surface are substantially perpendicular.

16. (Previously Presented) The apparatus of claim 14 wherein said second angle is approximately between thirty and sixty degrees.

17. (Previously Presented) A method for imaging a cross-section of a workpiece, said method comprising the steps of

exposing a cross-sectional surface of said workpiece by illuminating, along a first axis and onto said workpiece, a shaped ion beam limited by an aperture using ions generated by a low brightness ion source, and

illuminating said cross-sectional surface with a focused particle beam oriented along a second axis intersecting said first axis at a predetermined angle.

18. (Previously Presented) The method of claim 17 in which exposing a cross-sectional surface of said workpiece by illuminating, along a first axis and onto said workpiece, a shaped ion beam includes illuminating onto said workpiece a shaped ion beam using ions generated by an ion source having a brightness less than 100,000 amps per square centimeter per steradian.

19. (Previously Presented) The method of claim 18 in which illuminating onto said workpiece a shaped ion beam includes illuminating onto said workpiece a shaped ion beam

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using ions generated by an ion source having a brightness less than 10,000 amps per square centimeter per steradian.

20. (Previously Presented) The method of claim 17 in which exposing a cross-sectional surface includes directing a beam of ions generated by a non-liquid metal ion source.

21. (Cancelled)

22. (Previously Presented) A method for imaging a cross-section of a workpiece, said method comprising:

exposing a cross-sectional surface of said workpiece by directing, along a first axis and onto said workpiece, a shaped ion beam;

dithering said shaped ion-beam; and

illuminating said cross-sectional surface with a focused particle beam oriented along a second axis intersecting said first axis at a predetermined angle.

23. (Previously Presented) The method of claim 18 wherein said dithering step comprises the step of deflecting said ion-beam image with a periodic waveform.